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Recent Progress on the ACES Mission

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Atomic Clock Ensemble in Space (ACES) is an ESA mission in fundamental physics based on a new generation of clocks operated in the microgravity environment of the International Space Station.

Installed on the external payload facility of the Columbus module, ACES will accommodate two atomic clocks: PHARAO, a primary frequency standard based on samples of laser cooled Cs atoms, and the active hydrogen maser SHM. The two on-board clocks will generate a time scale with fractional frequency instability and inaccuracy of few parts in 10^{16} . The ACES frequency reference will be distributed on ground by a link in the microwave domain (MWL) and used to compare distant clocks. These comparisons will allow ACES to perform tests of the Einstein's theory of general relativity including an accurate measurement of the Einstein's gravitational red-shift, a search for time variations of fundamental constants, and tests of the Standard Model Extension. ACES will also develop applications in different areas of research including geodesy and Earth observation.

The engineering models of the on-board clocks and the main ACES subsystems are presently under test. The PHARAO clock reaches a fractional frequency instability of $2.3 \cdot 10^{-13}$ at 1 s, well in agreement with the interaction times possible on ground. MWL has already demonstrated performance levels compatible with mission requirements. After standalone test campaign, the engineering models will be assembled and integrated tests will verify the performances of the complete system releasing the manufacturing of the ACES flight model. Mission concept, scientific objectives, and status of ACES will be discussed together with the latest test results.